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Three new *Caeoma* species on *Rosa* spp. from Pakistan

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Abstract — Three representatives of the anamorphic genus *Caeoma* —*C. ahmadii* on *Rosa microphylla; C. khanspurense* and *C. rosicola* on *Rosa webbiana*— are described as new rust species from Pakistan. This first report of *Caeoma* raises the number of known anamorphic rust genera from the country to five.

Key words — Khanspur, Mansehra, *Phragmidium*

Introduction

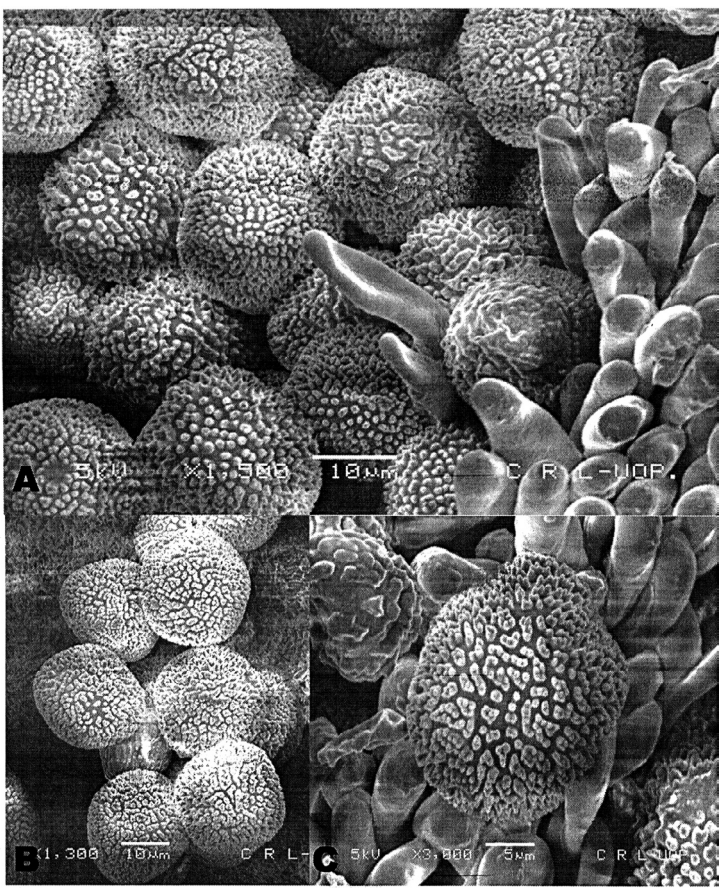
The genus *Caeoma* Link is traditionally used for species having sori that lack obvious bounding structures and that produce catenulate spores with intercalary cells. This contrasts with the genus *Aecidium* Pers., which has a cup-shaped sorus with a well-developed peridium. Similar sori are found in the aecial state of *Melampsora* Castagne and the uredinia of *Chrysomyxa* Unger, *Coleosporium* Lév., and other genera (Cummins & Hiratsuka 2003). The aecia of *Phragmidium* are (usually) *Caeoma*-type with catenulate spores or (less often) *Uredo*-type (Petrova & Denchev 2004) with verrucose or echinulate aeciospores. Cummins & Hiratsuka (2003) refer to the anamorphic genus *Lecythea* Léveillé the *Phragmidium* species with aecia corresponding to *Caeoma* III of Sato & Sato (1985). Because Hennen et al. (2005) regard *Lecythea* as confusing and not in use, we consider *Caeoma* the appropriate anamorph for accommodating species with *Phragmidium* aecia.

So far, 22 genera and 417 species of rust fungi have been described or reported from Pakistan (Afshan et al. 2008a,b,c,d, 2009a,b, 2010a,b, 2011a,b; Sultan et al. 2008; Afshan & Khalid 2009; Khalid & Afshan 2009; Iqbal et al. 2008, 2009), including four genera of anamorphic rust fungi, *Aecidium*, *Monosporidium* Barclay, *Peridermium* (Link) J.C. Schmidt & Kunze, and *Uredo* Pers. Although no representatives of *Caeoma* have been reported previously from Pakistan, three new *Caeoma* species occurring on *Rosa* are described here.

Materials & methods

Freehand sections of infected tissue and spores were mounted in lactophenol and gently heated to boiling point. The preparations were observed under a NIKON YS 100 microscope and photographed with a digipro-Labomed and a JSM5910 scanning electron microscope. Drawings of spores and paraphyses were made using a Camera Lucida (Ernst Leitz Wetzlar, Germany). An ocular micrometer was used for spore dimensions, with at least 25 spores measured for each spore stage. The rusted specimens have been deposited in the Botany Department herbarium, University of the Punjab, Lahore (LAH).

Taxonomy



Figs. A–C: *Caeoma ahmadii* (holotype), SEM micrographs. A: Aecidium containing aeciospores and paraphyses. B: Aeciospores. C: Detail of an aeciospore showing verrucose wall ornamentation (paraphyses visible in background).

Caeoma ahmadii Afshan, Khalid & Niazi, **sp. nov.** Figs. A–E

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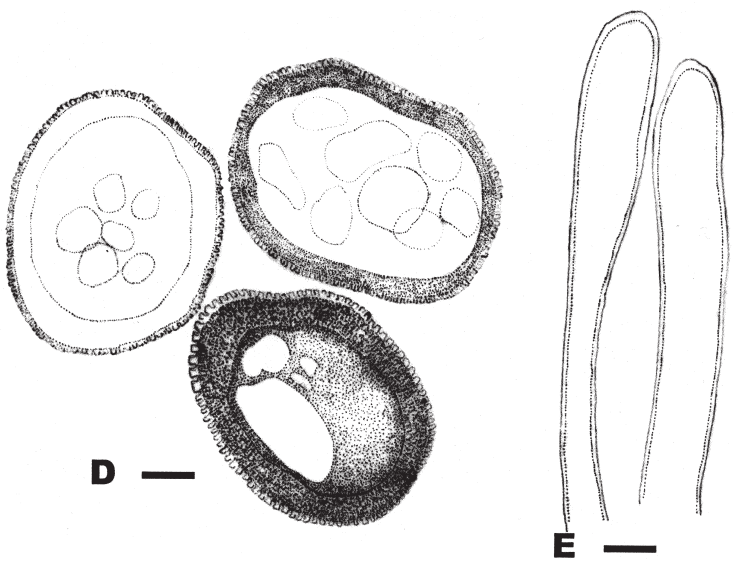
Differs from *Phragmidium tuberculatum* in larger aeciospores that are hyaline with orange-yellow contents.

Type: **Pakistan**, **Khyber-Pakhtunkhawah** (KPK), Ayubia National Park, at 2135 m a.s.l., on *Rosa microphylla* Desf., stage I, 18 June, 2008, N.S. Afshan & A.N. Khalid. NSA #151A (**Holotype**, LAH NSA1114).

Etymology: Named after the world renowned mycologist, Sultan Ahmad.

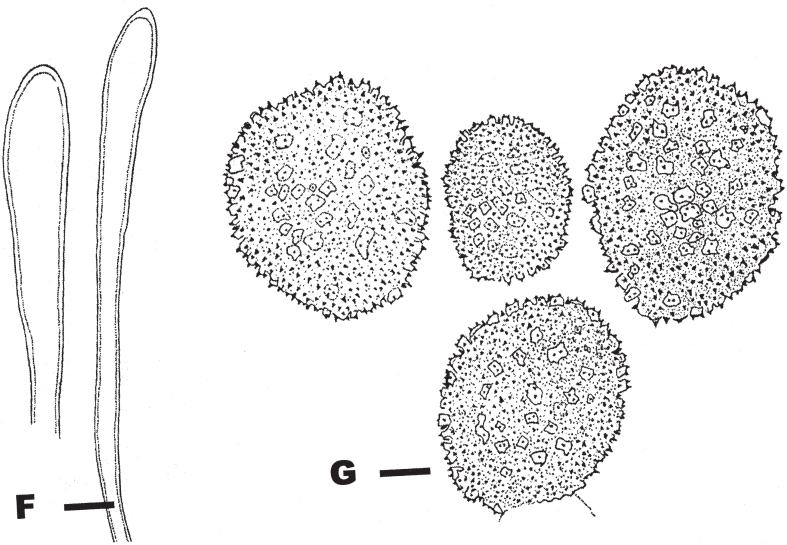
Spermogonia, uredinia and telia not found. Aecia hypophyllous, on leaves, bright yellow to orangish yellow, rounded or oblong, scattered, 0.1–0.3 × 0.09–0.10 mm. paraphyses numerous, erect to suberect, clavate, hyaline with light yellow granules, 50–70 µm long and 8–12 µm wide. Aeciospores globose to subglobose or ellipsoid to broadly ellipsoid, (23–)26–31 × 28–36 µm; wall 1–1.5 µm thick, hyaline with orange–yellow contents, densely verrucose, with 5–8 scattered pores.



Figs. D–E: *Caeoma ahmadii* (holotype), lucida drawings.
D: Aeciospores showing wall ornamentation. Scale bar= 9 µm.
E: Apices of paraphyses. Scale bar = 12 µm.

Comments: Aeciospores of *C. ahmadii* are larger than those of *Phragmidium tuberculatum* J.B. Müll. (18–24 × 20–30 µm), *Ph. mucronatum* (Pers.) Schtdl. (17–21 × 20–28 µm), *Ph. montivagum* Arthur (16–19 × 21–26 µm), *Ph. rosae-arkansanae* Dietel (16–23 × 23–27 µm), *Ph. speciosum* (Fr.) Burrill (16–24 ×

24–35 µm), and *Ph. rosae-pimpinellifoliae* Dietel (15–20 × 18–27 µm). They also differ in color and wall ornamentation from those of *Ph. tuberculatum*.



Figs. F–G: *Caeoma khanspurense* (holotype), lucida drawings.
F: Apices of clavate paraphyses. Scale bar = 20 µm. G: Mature aeciospores. Scale bar = 10 µm.

Caeoma khanspurense Khalid, Afshan & Niazi, **sp. nov.** Figs. F–G

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Differs from *Phragmidium mucronatum* and *Ph. tuberculatum* in larger aeciospores with verrucose wall ornamentation.

Type: **Pakistan**, **Khyber-Pakhtunkhawah** (KPK), Helipad, Khanspur, at 2135 m a.s.l., on *Rosa webbiana* Wall. ex Royle, stage I, 23 May 2006, N.S. Afshan & A.N. Khalid. NSA #03 (**Holotype**, LAH NSA1116).

Etymology: Named after the type locality, Khanspur.

Spermogonia, uredinia and telia not found. Aecia hypophyllous or caulicolous, on the veins, stems and petioles, scattered, rounded or oblong, 0.3–0.9 × 0.09–0.10 mm, orange yellow when fresh, surrounded by clavate paraphyses. Aeciospores globose, subglobose or ellipsoid to obovoid, pale yellow to orange-yellow, verrucose, occasionally with a plateau-shaped base, 23–32 × 23–41 µm, borne on one or two basal cells. Paraphyses clavate, hyaline, 70–105 µm long, 8–12 µm wide, with uniformly thin walls.

Comments: Aeciospores of *C. khanspurense* are larger than those of *Phragmidium mucronatum* (17–21 × 20–28 µm) and *Ph. tuberculatum* (18–24

× 20–30 µm); their verrucose ornamentation further distinguishes them from the aeciospores of *Ph. mucronatum*.

The broader aeciospores of *C. khanspurense* differ from those of *C. rosicola* (reported on the same host), characterized by verrucose to echinulate, 19–28 µm broad aeciospores.

Aeciospores with a verrucose wall ornamentation with a plateau-shaped base distinguish *C. khanspurense* from *Phragmidium rosae-pimpinellifoliae* with smaller aeciospores (15–20 × 18–27 µm).

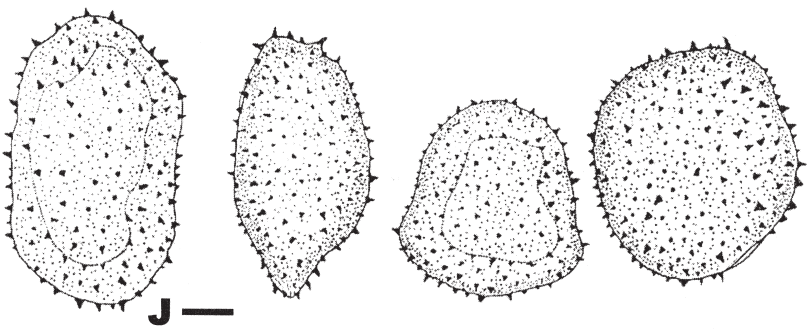


Fig. H: *Caeoma rosicola*, lucida drawing.
Aeciospores. Scale bar = 10 µm.

Caeoma rosicola Afshan, Niazi & Khalid, **sp. nov.** Figs. H–J

MycoBank MB 564318

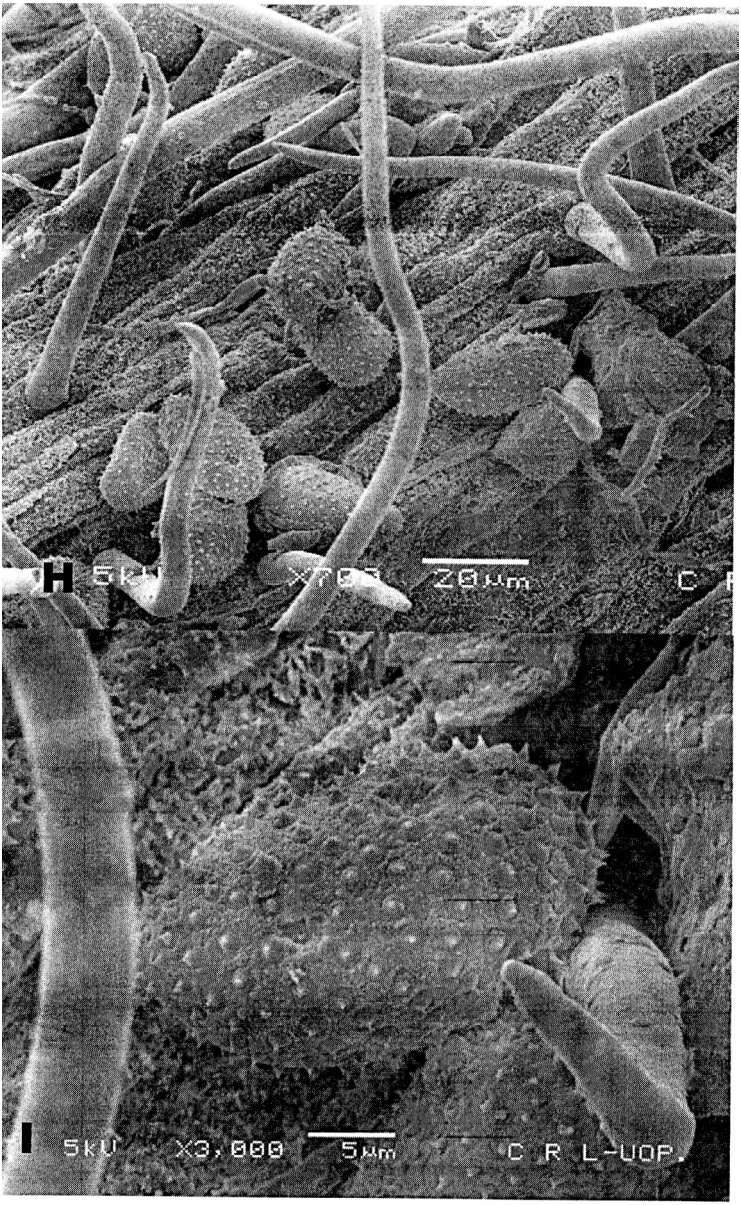
Differs from other *Caeoma* species in larger aeciospores and lack of paraphyses.

Type: **Pakistan**, **Khyber-Pakhtunkhawah** (KPK), Helipad, Khanspur, at 2135 m a.s.l., on *Rosa webbiana* Wall. ex Royle, stage I, 23 May 2006, N.S. Afshan & A.N. Khalid. NSA #02 (**Holotype**, LAH NSA1117).

Etymology: Named after the host genus, *Rosa*.

Spermogonia, uredinia and telia not found. Aecia hypophyllous or petiolicolous, mostly on the veins, petioles, branches and fruits, causing malformations, yellowish orange to bright orange, scattered. Paraphyses not observed. Aeciospores globose to subglobose or ellipsoid to ovoid; wall hyaline with orange yellow contents, echinulate to verrucose, 19–28 × 21–41 µm, germ pores 1–4, mostly equatorial.

Comments: Larger aeciospores and the lack of paraphyses differentiate *C. rosicola* from other rust species reported on *Rosaceae: Phragmidium rosae-pimpinellifoliae* (15–20 × 18–27 µm), *Ph. rosae-arkansanae* (16–23 × 23–27 µm),



Figs. I–J: *Caeoma rosicola* (holotype), SEM micrographs. I: Aeciospores. J: Detail of aeciospore showing echinulate wall ornamentation.

Ph. mucronatum (17–21 × 20–28 µm), and *Ph. montivagum* (16–19 × 21–26 µm). *Phragmidium montivagum* is further distinguished by aeciospores with 8 scattered germ pores.

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